DEPARTMENT OF AGRICULTURE, BENGAL.

ANNUAL REPORT

OF THE

DACCA AGRICULTURAL STATION

FOR THE YEAR

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CALCUTTA:

THE BENGAL SECRETARIAT BOOK DEPÔT.

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ANNUAL REPORT OF THE DACCA AGRICULTURAL STATION FOR THE YEAR 1912-13.

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ANNUAL REPORT OF THE DACCA AGRICULTURAL STATION FOR THE YEAR 1912-13.

Introduction.—Work at this farm during the year under review was continued on the same lines as in preceding years and as a result of the year's work we are able to add another crop—sugarcane—to the other two economical ones that we have been able to grow on this laterite area, viz.:—summer rice and winter rice. In fact a splendid crop of sugarcane was grown at the Dacca Farm in 1912 without irrigation. From 5½ acres of newly planted thick canes we obtained an average outturn per acre of 61⅓ maunds of *gur*, while from 5⅓ acres of ratooned thick canes we obtained an average outturn of 40⅓ maunds per acre. These results are phenomenal for the laterite soil of the Madhupur jungle. Whether this was only possible owing to the excessive rainfall of 1912 when 96½ inches on 95 rainy days between April —November were recorded on the farm, remains to be seen.

The weak point of this farm is the heavy expenditure incurred. This aspect is now receiving careful attention. In the year of Grace 1912 the Farm Superintendent reported to Government that he could not do certain works as he had religious prejudices against doing so. The young educated person thinks it his privilege to have a coolie to do any manual work for him. I mention these few points to let the ordinary reader know what a difficult problem Government is trying to solve when young educated men have to be taught practical agriculture. The Farm Superintendent in question is one of the most practical persons in the Department and passes his own bills. Apart from the expenditure in connection with the Laboratories and Botanical section the farm expenditure for April—March 1912-13 was Rs. 27,688-9-10 while receipts were only Rs. 11,653-7-3. Of this expenditure Rs. 6,500-14-4 were for establishment. The Deputy Director of Agriculture is erroneously considered by many to be responsible for expenditure on this farm. This is entirely wrong. During the period April—March 1912-13 there were many practices on this farm against which I was opposed. These were independence of Farm Superintendent, excessive expenditure on farm cattle, the keeping of a

workshop on this farm for the purpose of manufacturing implements, the supply of labour to the experts without keeping the accounts separate, etc. Since 1st April 1912 conditions have radically altered on this farm. We have now only the small cultivator in Bengal of 5 to 10 acres to consider. We have not yet arrived at the stage that we can place a farm in independent charge of a Superintendent.

As a result of experience in Bengal at present it may be accepted on Government farms that the ordinary expenditure of the farm *plus* cattle food and repairs should be balanced by the sale-proceeds but not establishment, and any farm that is not working up to that standard requires serious attention. With experience in a few years establishment will also be payable out of farm receipts, and there is no reason in time if every one does his duty, why there should not be a surplus.

The primary object of Government is not to make money on these farms, but to teach young men the dignity of labour and how to earn a livelihood from agriculture besides finding out definite improvements that can be applied by the cultivators. The Botanist, Chemist and Fibre Expert are doing purely research work, and their expenditure is entirely separate from the results obtained. The agriculturist has to apply their recommendations and his expenditure requires careful attention or entirely wrong conclusions may result.

In 1912-13 apart from fodder and grazing Rs. 1,885-12-6 were spent on cattle food, whereas I consider about Rs. 600 ought to have been spent.

There is a workshop at this farm for repairing implements where a blacksmith and his help with a joiner and his help work. The farm erected most of the buildings on this station so a workshop was necessary, but under present conditions I consider one man occasionally is all that is necessary to keep the implements repaired and in order.

Suggestions that would sap the energies of the agricultural staff have been made, such as manufacture of bonemeal and manufacture of mustard oil and cake. We know little of these industries and yet the above would mean competing with such experts as Burn & Co., and Ram Narayan Banerjee & Co., for

agricultural machinery—Mackillican & Co. for manufacturing bone-meal and the big oil mills on the Hooghly for manufacturing oil cake. Fortunately these ideas have been dropped on this farm. We have quite sufficient work to do with ordinary cultivation without anything else.

Besides the above the farm pays for ploughs and ploughmen for doing the work of the Economic Botanist, for all the expenses of cultivation for the fibre expert and for any practical work on the farm required to be done for the Agricultural Chemist.

Finally the farm pays for keeping the place clean and for the repairs of the quarters of the Laboratory Assistants. Accordingly it is not surprising that the total expenditure in 1912-13 was very heavy.

As a result of the work at this station we are able to recommend the following for this laterite area:—

A.—Winter Rice (Aman Dhan).

(*a*) *Varieties.*

(1) Maloty (white medium grain).
(2) Lohadang (very coarse red).
(3) Lalbalam (red).
(4) Kataribhog (very fine white).
(5) Badshahbhog (ditto).
(6) Dadkhani (ditto).

(*b*) *Manures.*

(1) Bonemeal, 3 maunds per acre.
(2) Dhaincha green manure.
(3) Fish manure.

B.—Summer Rice (Aus Dhan).

(*a*) *Varieties.*

(1) Larcose (fine).
(2) Surjumukhi (fine).
(3) Gorfa (coarse, very early).

C.—Sugarcane.

(*a*) *Varieties.*

(1) Barbadoes No. 147 B.
(2) Striped Tana.
(3) Yellow Tana.
(4) Barbadoes No. 208 B.
(5) Dacca Gandheri.

(*b*) *Manures.*

Liming.	300 maunds cowdung ...	per acre.
	20 do. castorcake ...	

This station serves as a store for seeds, manures and implements for the two divisions of Dacca and Chittagong, and although there has been a larger demand during the year at this seedstore than at any of the others the public apathy for our work is still very apparent.

In concluding these few remarks, I must not forget the apprentices. Eight received training during the year, and they have all been taken for demonstration work in the districts.

2. *Situation and brief history.*—This station is situated at Manipur, 5 miles out of Dacca. Area is 350·7 acres, of which 286·6 acres are high land, the remainder being low land. The land is representative of the laterite area, of which there is a fairly large area in the Province. No arrangements have been made for irrigation as yet, and although the rainfall is fairly heavy and the water level in the rainy season comes to near the surface of the soil, from November to March, the land becomes as hard as a brick and is unsuitable for the growth of crops. The soil is suited to *aus* and *aman* paddy, and in 1912 sugarcane has been grown economically, but the returns from other crops have so far been heart breaking, considering the amount of time, trouble and money spent upon them. A heavy turnwrest plough that costs Rs. 30 and that requires four big bullocks to pull turns up this soil very well. It may be useful to those people who are reclaiming jungle and who cannot procure the necessary labour.

This station is situated in 23°7 north latitude, and 90°4 east longitude at Manipur, 5 miles from Dacca, and is representative of a large tract of country in the Dacca district known as the

Madhupur jungle. The area is laterite which is remarkable for the rapidity with which water drains away. The land was acquired in 1906, when most of the high land was under jungle and thatching grass. To begin with, the farm had to be laid out, roads built, buildings erected and the land brought into a fairly uniform condition before experimental work could be commenced. This work is only now nearing completion. The high-land soil is so barren that the only crops that have been grown economically are *aus* paddy and sugarcane. Continued ploughing of green-manure (*dhaincha*) with applications of lime has improved the soil to some extent, and we hope to grow now other crops economically.

Many trees have had to be felled and removed to enable us to obtain compact areas large enough for experimental work.

The superior staff of the Department have their head-quarters and laboratories on this farm.

3. *Area.*—The area of the farm is 353·7 acres and of this 286 acres are high land, while 69 acres are low land. Most of this high land in 1906 was under jungle, but yearly reclamation work has been undertaken until at present we have 141 acres of this land under cultivation while 123 acres are taken up by buildings, roads, tanks, botanical area and paddocks so that practically speaking the whole farm is now under cultivation. During the year one acre more of high land was brought under cultivation. This high land so far has only been able to grow *aus* paddy and sugarcane economically. The 69 acres of low land are all under cultivation. Good crops of *aman* paddy can be grown on this land.

4. *Irrigation.*—There is no artificial irrigation on this farm. The normal rainfall of the district is about 72 inches and this is spread well over the period from March to October, so that the ordinary crops of *aus* and *aman* paddy, as grown by the cultivators of this class of land, are assured. The high land of this farm however cakes as hard as a brick in December, and it is very questionable if *rabi* crops can be grown on this area economically, while if irrigation be arranged it is very doubtful if the cost of irrigation would be recovered.

The low lands remain moist till December and yield heavy crops of *aman* paddy.

5. *Character of the soil.*—As stated above, there are two types of land and crops on this farm. The soil of the low land is very fertile, while that of the high land is very poor and, where it has not been treated, even barren. The high land soil is poor in phosphates, contains no lime and contains a large amount of iron, while the land suffers from drought in December and January, so it is not surprising that *rabi* crops sown in October, to be ready for harvesting in February, March, have so far been uneconomical. I am indebted to A. Meggitt, Esq., Agricultural Chemist, for the following exhaustive and interesting report of the soils of this farm,

"In this paragraph an account of the chemical and physical characteristics of the soil, so far as determined to date, is given.

The work may be classed under three heads:—

(*a*) Chemical analysis.

(*b*) Mechanical analysis.

(*c*) The determination of certain physical contents.

Chemical analysis.

"Report on the High-land soil of Dacca Farm."—

	Soil—Laboratory sample No. 3.	Sub-soil—Laboratory sample No. 3a.
Organic matter combined water ...	4·66	4·38
Nitrogen	0·134	0·093
Soluble in hydrochloric acid:—		
Phosphoric acid ... (P_2O_5) ...	0 04	0·04
Potash ... ... (K_2O) ...	0·30	0·49
Lime ... ... (C_aO) ...	0·18	0·10
Magnesia ... ... (M_gO) ...	0·38	0·33
Soluble in 1 per cent. citric acid.—		
Phosphoric acid ... P_2O_5) ...	0·003	0·002
Potash ... ... (K_2O) ...	0·013	0·008
Calcium Carbonate	0·02	0·018
Re-action of soil	Acid.	Acid.

Ferrous iron is present in the sub-soil during the rainy season.

The soil samples from the Dacca Farm were taken from a typical high-land area and may be taken to very fairly represent all the high-land of the farm and very probably all similar land in the large tract known as Madhupur jungle. The particular area in question had not been cultivated nor manured in any way at the time of sampling. The jungle had merely been cut down and rooted up. The surface soil when undisturbed extends uniformly to a depth or 4 or 5 inches, is darker in colour and altogether different in appearance from the sub-soil underlying it. One would term it a "stiff clay loam." The sub-soil underlying the above extends to a considerable depth and is of a deep red colour. It is composed of heavy red clay, and resembles the laterite soils of Southern India very closely. Wherever the surface of the land has been disturbed during levelling work and wherever ant-hills have accumulated, there the red sub-soil comes to the surface, and this is generally accompanied by barrenness in those spots. I am of opinion that the surface soil has been derived from the underlying sub-soil and has not been merely super-imposed, the difference observable being due to the effect of surface vegetation and increased oxidation at the surface and that by suitable tillage and cultivation the nature of this sub soil can be materially altered and improved. This however will take time, but can no doubt be accelerated by suitable treatment. The high-land soil of the whole farm is undoubtely in very bad condition, physically, biologically and chemically.

The soil is difficult to work and owing to the presence of innumerable small nodules or accretions apparently of iron oxides in the soil it is almost impossible to get a fine tilth on the surface; in spite of the fact that the soil is capable of absorbing a very large amount of water during the rainy season and thereby becoming almost puddled, its capacity for retaining moisture is very small, and it very readily parts with the whole of this water immediately the rains cease and cracks badly; to such an extent is this the case that it is at present almost impossible to grow *rabi* crops on this class of soils, for lack of moisture.

I believe the soil also to be in a bad condition biologically from several considerations: Firstly, so far as tested by me (and I have tested soil from many parts of the farm), the soil is all in a more or less acid state. Acidity is quite inimical to the

well being of those soil organisms, whose presence is most to be desired. An acid soil is never a healthy one. Bacterial life generally is suppressed in favour of the growth of moulds and micro-fungi which compete actively with the crop for the plant food of the soil.

This acidity is well reflected during the rains in the natural herbage. As observed by me, this consists chiefly of sedges and other acid-loving plants. Wherever these abound one may be sure that an unhealthy soil condition exists.

Again, I have observed that the root nodules common to leguminous plants never develop on the roots of peas sown on this land, unless the soil is very heavily manured with cow-manure.

I do not offer any explanation of this fact. I merely record it as evidence against the general bacteriological condition.

Turning to the analytical figures, the first point one would wish to emphasize is the abnormally low percentage of lime carbonate (calcium carbonate).

The total lime present is also very deficient.

In the analysis of a soil without doubt the most important figure is the proportion of lime carbonate. It affects a soil in every way beneficially, physically, chemically and bacteriologically, besides indicating what class of artificial manures should be used. It improves the texture of a soil, favouring the penetration of both water and air and of the roots themselves. It neutralises acidity in the soil, maintaining these conditions necessary to abundant bacterial life and activity, more especially those of the decay and nitrification of organic matter, thus supplying the readily assimilable form of nitrogen. Also it favours the development and activity of the root bacteria of legumes, and of the non-symbiotic nitrogen assimilating bacteria, the azotobacter, etc.

A proper proportion of lime carbonate also tends to keep the land free from fungoid disease.

Chemically it tends to counteract the deleterious influence of an excess of magnesia in the soil and renders available directly or indirectly the reserves of plant food—phosphoric acid and potash, which may be present. It also admits of the proper action of any manures added. In its absence they do not exert their

proper and full action. Lime in a soil also tends to prevent the formation, or at any rate the accumulation, of compounds toxic to most plant life.

The preferential washing out of lime rather than other plant food is well known and one cannot wonder that years and years of heavy rainfall have nearly robbed the soil of the whole of its lime; it is a process which is continually going on.

The ratio of magnesia to lime is also rather higher than one would desire, being 2 : 1 for surface and 3 : 1 for sub-soil.

Of total potash in the soil there is no dearth, but the total posphoric acid is certainly quite inadequate. Potash available to plants is also present in quite sufficient quantities and I do not see any necessity of special potash manuring. Suffiicient will be supplied in ordinary applications of cow manure to keep up the supply of this food.

The amount of phosphoric acids available to plants as shown by that soluble in 1 per cent. citric acid is very low, and this combined with the small amount of total phosphoric acid present points to the fact of a "real" and not merely a temporary lack of this food ingredient. I am of opinion that phosphoric acid manuring will be decidedly advantageous.

In considering what form of phosphate to apply to this soil one must bear in mind that the soil is very deficient in lime and acid in nature. This precludes the application of any manure of an acid nature (such as superphosphate). Basic slag would undoubtedly be eminently suitable. It would supply lime as well as phosphoric acid. In view however of its excessive cost I should advise liming, together with the application of bonemeal to supply the phosphoric acid. The organic matter in these soils though (judging from the loss on ignition and the percentage of nitrogen) not so deficient as one might expect might be advantageously increased. Fertility will never be maintained by the use of mineral manures alone. Green-manuring with leguminous crops will increase the supply of organic matter and nitrogen and will improve the water-retaining capacity, but I very much question whether green-manuriug will have the desired benefical effects unless liming be first restored to. Besides he purely chemical evidence afforded as to the necessity of (*a*) green-manuring, (*b*) the application of lime, (*c*) phosphatic

manuring, I have the field evidence of some five years to work on. There is field experience strongly in favour of all the above as reference to recent reports will show.

Report on the analysis of low-land paddy soil, Dacca Farm, Table I.

Laboratory No. 4.

(*a*) Soluble in hydrochloric acid with 12 hours digestion at 100 C—

	Per cent.
Phosphoric acid (P_2O_5)	0·027
Potash (K_2O)	0·269
Lime (C_aO)	0·154
Magnesia (M_gO)	0·279

(*b*) Soluble in 1 per cent. citric acid with 7 days' digestion—

Phosphoric acid	0·003
Potash	0·006
(*c*) Moisture	5·80
Organic matter and combined water ...	3·66
Nitrogen	0·127
Calcium carbonate	Trace (0·002)
Reaction	Acid.

Mechanical analysis of the high-land soil of the Dacca Farm.

	Surface soil—Laboratory sample No. 3.	Sub-soil—Laboratory sample No. 3(*a*).
	Per cent.	Per cent.
Fine gravel	1·5	1·4
Coarse sand	2·9	2·1
Fine „	30·5	25·1
Silt	29·5	25·8
Fine silt	8·4	9·9
Clay	19·3	32·1

Report.—Both these samples show very small proportions of the coarsest fractions, *i.e.*, coarse sand and gravel, with a preponderance of the medium grades, the fine sand and silt fractions; a moderate amount of clay is present in the surface soil, and a good deal in the sub-soil. The surface soil is not a true clay, despite the fact that it is heavy to work and during the rainy season resembles a clay. In a wet condition the clay properties of this soil are no doubt aggravated by the lack of calcium carbonate and humus. In the absence of calcium carbonate the clay particles are not flocculated, but exist in an extremely fine state of division, thereby making the soil appear more clayey than it otherwise would. The lack of coarse sand and gravel also tend to keep the soil very close and compact, while the absence of carbonate of lime renders it stickier and harder to work.

A soil such as this which contains such an amount of the silt grades and clay, should however not dry out as this one does during the dry weather. Bad tilth due to lack of humus and the fact that the land is cut up by holes several feet deep which provides underdrainage, no doubt are responsible for this adverse cold weather aspect.

To keep a soil of this nature in good tilth requires good stores of humus, and a good deal more calcium carbonate than exists. Soils containing a higher proportion of the clay fraction than this will give a good tilth with ordinary care, providing the other factors are right.

Stiff soils require not only enough carbonate of lime to keep down acidity, but also sufficient to keep the texture right, and the amount present in this soil is not enough to do either.

The sub-soil contains considerably more of the clay fraction, and rather less of the silt and sand fractions than the surface soil, while the coarsest grades are again very low.

It is altogether stiffer and more clayey in character than the surface soil.

These characteristics enable this soil to retain its water somewhat better in the dry months, a sudden increase in the percentage of water being found at a comparatively small depth in the cold weather months.

The sub-soil, however, takes on such a peculiarly cheesy and intractable character at this time of year as not only to prevent the free movement of moisture, but also to prohibit the easy entry of plant roots, and only deep cultivation combined with addition of large supplies of organic matter will in my opinion effect an improvement.

The use of lime also in the surface soil will, by the flocculating action of the descending soluble bicarbonate, again assist in the amelioration of these adverse sub-soil conditions.

TABLE II.

Physical constants

SAMPLE.	MAXIMUM.			MINIMUM.				
	Water absorbed per 100 of dry soil.	Per cent. of water in saturated soil by weight.	Per cent. of water in saturated soil by volume.	Per 100 of dry soil.	Per cent. by weight.	Per cent. by volume.	Maximum hygroscopic capacity.	Per cent. of water when air dry.
Dacca high-land surface soil, laboratory No. 3.	49·6	33·2	53·5	12·9	11·2	13·8	5·2	2·7
Dacca high-land sub-soil. Laboratory No. 3*a*.	48·6	32·6	52·7	12·4	10·8	13·4	6·1	3·7

NOTES ON TABLE II.—PHYSICAL CONSTANTS.

"These constants bear out what may also be gathered from the chemical analyses, viz., that the surface and sub-soils are essentially similar, and owe what differences they possess to the effects of cultivation, and slightly more organic matter in the upper layers.

The hygroscopic capacity is lower than one would expect for this class of soil, due no doubt to lack of humus.

Generally speaking, it means that only water in excess of about 6 to 7 per cent. is available to crops, and plants will

begin to wilt even before the soil moisture is reduced to that figure.

Examination of the highland soil during January, when soil moisture is very low, has shown that the average percentage of water in the first foot of soil is only of the order of 7 per cent. or so.

In the light of the above facts, the failure of certain *rabi* crops, which normally cover the ground until late in the cold weather, *e.g.*, oats, to mature their crop, becomes intelligible.

In regard to the maximum and minimum water saturation constants, the figures are lower than are cited for somewhat similar class of soil in Europe: they suggest that the optimum proportion of water for the growth of crops is some 14—17 per cent. figures which are exceeded during the rains, sometimes for extended periods, and on the other hand not approached, except beyond average root range, during the cold weather.

The figures for minimum saturation capacity in particular are very much lower than those cited for similar soils in Europe, particularly due no doubt to the lower content of humus which obtains here. These figures are extremely important in gauging a soil's power to retain a reserve of moisture during dry periods, and theory and experience agree well in placing this capacity very low.

Taken as a whole the figures suggest bad physical soil conditions generally, due largely probably to the low content of organic matter and calcium carbonate as a result of which the properties one usually associates with clay soils are aggravated, so that the soil becomes very sticky when wet, and also dries out into a hard cake through which young plants can only force their roots with difficulty. Much can be done no doubt by careful cultivation and adequate additions of organic matter and calcium carbonate, and it will take years to accomplish, but while it will thus almost certainly be possible to ensure large and paying outturns in the early cold weather crops, such as mustard and *mati kalai*, in my opinion those *rabi* crop which cover the ground until the end of January or well into February will certainly need irrigation to bring them to maturity." (Meggitt.)

N.B.—Further information in regard to certain other aspects of the soil of this farm appears in the annual reports of the work of the Agricultural Chemist.

6. *Meteorology.*—The following table gives the actual rainfall and number of rainy days on the Dacca Farm with the normal rainfall of the Dacca district:—

RAINFALL, DACCA FARM.

	Actual.	Number of rainy days.	Normal.	Normal number of rainy days.
1912.	Inches.			
April ...	9·0	13	4·88	6·7
May ...	6·6	8	9·60	11·3
June ...	24·4	15	13·38	15·2
July ...	12·0	18	12·85	17·4
August ...	13·8	20	12·55	17·4
September ...	6·8	12	9·43	11·7
October ...	9·34	6	4·34	5·8
November ...	4·7	3	0·81	1·1
December ...	...	...	0·15	0·4
1913.				
January ...	...	...	0·38	0·9
February ...	...	...	1·12	1·8
March ...	1·21	3	2·59	3·5
	84·88	98	70·28	93

From the figures it will be seen that the actual rainfall of 1912-13 was well above the normal. These figures show that the recorded rainfall was 25 above the normal, and that there was plenty of natural rainfall for growing all crops between April and November 1912.

The year 1912 meteorologically was favourable to jute, *aus*, paddy, *aman* paddy and sugarcane on the Dacca farm. The heavy rainfall from April to November 1912 allowed of a heavy crop of sugarcane being grown on laterite without irrigation.

A.—General crops grown.

7. *Operations during the year.*—The following table gives the area of each crop grown on the farm during 1911-12 with the total outturn and yield per acre :—

Crop.	Area sown.	Total outturn.	Yield per acre.	Remarks.
	Acres.	Mds.	Mds.	
Winter rice (aman dhan).	65	1,273	19½	Good.
Autumn rice (aus dhan).	101	1,810	18	Do.
Sugarcane—				
(*a*) New crop ...	5½	344	61⅘	Very good.
(*b*) Ratooned ...	5⅓	215⅕	40⅓	Good.
Jute	1⅔	18	11	Fair.
Mati kalai ...	11	46	4⅕	Bad.
	18⅔	were fed off to bullocks.		
Niger	25	69	2⅘	Bad.
Mustard	10	22¼	2¼	Do.
Til	6	14½	2⅖	Do.
Rahar	6	39	6½	Fair.
Juar	6⅔	Fair	Fed off to bullocks.	
Soybean	¾	1⅘	2⅖	Bad.
Cowpeas	2	3½	1¾	Do.
Dhaincha ...	14	Green manured.		

From these figures it will be seen that only winter rice summer rice and sugarcane gave satisfactory returns. Jute was unsatisfactory, *rahar* was only fair, while the remainder were bad. It must therefore be concluded that this tract of country is not suited to *rabi* crops.

B.—Experimental Work.

This work is divided into—

(1) Winter rice (*aman dhan*).

(2) Autumn rice (*aus dhan*).

(3) Sugarcane.
(4) Botanical area.
(5) Area devoted to fibre plants.
(6) Area devoted to Agricultural Chemist.

Nos. 4, 5 and 6 are under Messrs. Hector, Finlow and Meggitt, the Economic Botanist, Fibre Expert and Agricultural Chemist, respectively, who deal personally with these areas in their annual reports. In addition to this during the year under report a large area was allotted to Mr. Hector for his varietal work on rice.

1. *Winter rice*—(*a*) Varieties, (*b*) Manure (*c*) Methods of cultivation.

(*a*) *Varieties.*—The following table gives full details of varieties, area under each and yield per acre:—

Dacca Farm—Aman Paddy (winter rice) transplanted, 1912.

Varieties.	Area.	Outturn.	Yield per acre.
Fine—	Acre.	Mds.	Mds.
(1) Maloty	12⅔	295	23¼
(2) Karticsal	7	142	20⅓
Red Medium—			
(3) Lalbalam	6⅓	144½	23
(4) Chaplash	5½	117¼	20
Coarse red—			
(5) Lohadang	5½	158	28½
(6) Hatisal	3½	55¼	15⅘
(7) Chingura	6½	104	16
(8) Manikimadura	½	11	22
(9) Govindabhog	½	10¼	20½
(10) Kataribhog	½	16	32
(11) Khalajoha	½	8½	17
(12) Kalijira	¼	4½	18
(13) Badshabhog	3/10	8	26
(14) Dadkhani	⅔	13	19½
(15) Tulsimala	⅖	6½	16

At present then we are able to recommend Maloty, Lohadang, Lalbalam, Kataribhog, Badshabhog, and Dadhkani varieties for this tract of country. Mr. Hector has much useful work in hand in connection with varieties of winter rice, and we hope he will be able to give us a few varieties shortly for trial on a practical scale.

(*b*) *Manures.*—This experiment was commenced in 1908. Manures were applied in 1908 and 1909 after which they were discontinued and the residual effects are now being observed.

The following tables gives the manurial applications with the average outturns for 1908 and 1909 with the actual outturns for 1910, 1911 and 1912:—

Per acre—Average of duplicate plots.

Manures applied, 1908-09.	Average of 1908-09.		1910, without manure.		1911, without manure.		1912, without manure.	
	Yield.							
	Grain.	Straw.	Grain.	Straw.	Grain.	Straw.	Grain.	Straw.
	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.
Green-manure (Dhaincha) ...	24	32	19	12¾	22	50	16	32
Ditto (Sunnhemp) ...	14	17⅜	14⅛	0⅛	19	34	15½	31¼
Unmanured	17	25¾	22	14	19⅛	47	12½	24
Bonemeal 3 maunds	24	44¾	25	18⅛	25¾	62½	19½	50
Ditto 3 maunds and saltpetre 30 seers.	23⅛	40⅛	22¼	19	23	62¾	19	35
Ditto 3 maunds and ammonium sulphate.	22⅛	41	26	20	20¾	45¾	16¼	23
Ditto 3 maunds and calcium nitrate.	26⅛	38	26	22	24½	54	20	24
Ditto 3 maunds and cotton seed.	24	39¼	25¼	22½	23¾	56¼	20	32
Fish manure	32½	35	21½	22¼	18¾	37¼	16	34

From the figures both bonemeal and dhaincha seem still to be affecing the yield per acre. Bonemeal has the greatest residual effect, while fish manure, which gave the highest return in the years of application seems to have no subsequent effect.

(*c*) *Methods of cultivation.*—(1.) Planting and spacing experiments have been carried out for three years. One, two, three and four seedlings in a bunch are transplanted at distances apart of 8 inches, 10 inches and 12 inches. The yields per acre figures show that the differrence due to want of uniformity in the plots is greater than the number of seedlings and the distance apart in transplantation, so no figures are published.

(2.) *Seed rate in seed beds.*—The following table gives some very interesting results of the amount of seed used per acre in seed beds for producing transplants. It would seem sufficient to sow 1½ maunds of seed per acre in seed beds for winter rice:—

OFFICE RAVINE PLANTING EXPERIMENTS, 1912-13.

Paddy—Maloty.

Plot No.	KIND OF SEED-BED.	Area sown.		WEIGHT PER PLOT.		Grain Outturn per bigha of grain.	REMARKS.
				Grain.	Straw.		
		Cottah.	S. ft.	Mds.	Mds.	Mds.	Mds.
24	Seedlings raised from seed-bed sown at 2 maunds per bigha.	4	429	1½	1½	6½	
31A	Ditto ...	3	20	1⅝	2½	11	
31B	Ditto ...	4	298	1⅞	1¾	8	Average per bigha ... 8½
25	From seed-bed sown at 1 maund per bigha.	4	355	1⅜	1¾	6	
26	Ditto ...	3	492	1½	1⅜	6½	
27	Ditto ...	5	216	2½	3⅜	8¾	Ditto ... 7
29B	From seed-bed sown at 30 seers per bigha.	3	9	1⅜	1¾	6	
30A	Ditto ...	7	264	3⅞	6⅛	10	
30B	Ditto ...	7	261	3⅞	4⅜	10½	Ditto ... 8½
28A	From seed-bed sown at 20 seers per bigha.	3	445	1¾	2½	10	
28B	Ditto ...	4	527	2½	3	9½	
29A	Ditto ...	3	306	2	3	12	Ditto ... 10

(2) Ploughing after harvest *versus* leaving the land till the rains before ploughing. The following table seems to point out an advantage from ploughing up the land immediately after harvesting winter rice:—

EAST RAVINE CULTIVATION EXPERIMENT, 1912.

Paddy—Karticsal.

Plot No.	KIND OF TREATMENT.	Area sown.		WEIGHT PER PLOT.		Grain Outturn per bigha of grain.
				Grain.	Straw.	
		Bigha.	Cottah.	Mds.	Mds.	Mds.
26, 29 & 30 ...	Ploughed immediately after harvest of winter paddy in 1911.	....	18	7½	10½	8½
27, 28 & 31 ...	Unploughed, *i.e.*, ploughed May and June.	...	18	6	8	7

2. *Autumn rice (Aus dhan)*—

Varieties.—The following varieties of *aus dhan* were sown broadcast in April and the crop was ready for harvesting in July-August. The following table gives full details of variety, area, outturn and yield per acre in each case:—

Summer rice (aus paddy).	Varieties, 1912.		
	Area in acres.	Outturn.	Yield per acre.
		Mds.	Mds.
Puki	23	266	11½
Moishlum	6⅓	94¼	14
Boaljuri	16⅓	302	18⅓
Larcose	4⅓	122	28⅓
Surjumukhi	16½	392½	23⅜
Fulbadam	8	137	17
Pankaiji	9⅔	188¼	20
Gorfa	10	229¾	23
C. P. Fine	6½	65	10

Gorfa.—White grain, very coarse, sheds very easily.

Surjumukhi.— } Red. Fine grains.
Larcose— }

Boaljuri.—White fine grain.

Puki is an early variety of *aus* rice suitable for low lands to be followed in the same year by transplanted winter rice.

From the above figures we are able to recommend Larcose. *surjumukhi* and Gorfa varieties of autumn (*aus dhan*) rice.

3. *Sugarcane.*—Varieties.

A variety experiment on sugarcane was made with truly remarkable results as will be seen from the following table:—

Result of varietal sugarcane experiments North Mirpur, 1912-13.

N.B.—Area under each variety = $\frac{1}{10}$th acre.

Series.	Variety of canes.	Number of canes.	Weight of canes.	Weight of juice.	Weight of *gur*.	Number of canes per acres.	Outturn of canes per acre.	Outturn of juice per acre.	Outturn of *gur* per acre.	Per cent. of juice to canes.	Per cent. of *gur* to juice.
			Mds. s. ch.	Mds. s. ch.	Mds. s. ch.		Mds. s. ch.	Mds. s. ch.	Mds. s. ch.		
I	147B	1,871	90 36 5	65 31 10	11 18 0	18,710	909 3 2	657 36 4	114 20 0	...	...
II	Barbados	1,902	94 6 9	70 3 11	13 7 11	19,200	941 25 10	700 36 14	131 36 14	...	...
III	Ditto	1,697	3 57 13	67 30 7	12 16 12	18,970	939 18 2	677 24 6	124 7 8	...	...
Average of Triplicates		1,890	93 0 3	67 35 4	12 14 2	18,900	930 2 4	678 32 8	123 21 7	72·9	18·14
I	Striped Tana	1,425	105 26 12	67 32 9	11 34 12	14,250	1,056 27 8	678 5 10	118 27 8	...	...
II	Ditto	1,385	95 36 2	65 12 0	11 9 7	13,850	959 1 4	653 0 0	112 14 6	...	...
III	Ditto	1,296	92 26 6	64 32 0	10 22 10	12,960	924 23 12	648 0 0	105 26 4	...	...
Average of Triplicates		1,369	98 3 0	65 38 14	11 8 15	13,687	980 4 2	659 28 8	112 9 6	67·25	16·9
I	Dacca Gandaries ...	2,464	69 32 0	48 22 12	8 8 8	24,640	698 1 0	485 27 9	82 1 14	...	...
II	Ditto	2,373	65 34 12	42 26 9	8 1 11	23,730	658 27 8	426 25 10	80 16 15	...	...
III	Ditto	1,024	55 1 0	38 3 10	7 6 14	10,240	550 10 0	380 36 4	71 28 12	...	...
Average o Triplicates		1,954	63 22 9	43 4 5	7 32 4	19,537	635 25 13	431 3 2	78 2 8	67·87	18·09

Series.	Variety of canes.	Number of canes.	Weight of canes.	Weight of juice.	Weight of *gur*.	Number of canes per acre.	Outturn of canes per acre.	Outturn of juice per acre.	Outturn of *gur* per acre	Per cent. of juice and canes.	Per cent. of *gur* to juice.
			Mds. s. ch.	Mds. s. ch.	Mds. s. ch.		Mds. s. ch.	Mds. s. ch.	Mds. s. ch.		
I	Yellow Tana	1,408	89 6 14	47 1 7	9 38 13	14,080	891 28 12	570 14 6	99 28 2	...	...
II	Ditto	1,447	93 11 2	62 27 11	11 26 0	14,470	932 31 4	626 36 14	116 20 0	...	...
III	Ditto	1,430	90 21 15	60 35 3	10 11 3	14,300	905 19 6	608 31 14	102 31 24	...	...
Average of Triplicates		1,428	91 0 0	60 8 2	10 25 5	14,283	909 39 13	601 37 11	106 13 5	66·11	12·64
I	208B	1,850	66 25 10	47 11 9	9 4 5	18,500	666 16 14	472 35 10	91 3 2	...	...
II	Barbados	1,522	56 6 2	43 0 10	8 23 10	15,220	561 21 4	430 6 4	85 36 4	...	...
III	Ditto	1,678	55 7 0	38 0 0	7 11 3	16,780	551 30 0	380 0 0	72 35 2	...	...
Average of Triplicates		1,603	59 12 15	42 30 12	8 13 4	16,833	593 9 3	427 27 5	83 11 8	72	19·44
I	Striped Mauritius ...	866	20 3 6	12 15 6	2 0 8	8,660	200 33 12	123 33 12	20 5 0	...	...
II	Ditto	878	12 26 4	8 21 4	1 17 5	8,730	126 22 0	85 12 8	14 13 2	...	...
III	Ditto	996	23 35 2	13 29 12	2 2 12	9,960	238 31 4	137 17 8	20 27 8	...	...
Average of Triplicates		912	18 34 15	11 22 2	1 33 8	9,117	188 29 3	115 21 4	18 15 3	61·17	15·65*
I	376B	637	16 15 2	9 17 4	1 30 12	6,370	163 31 4	94 12 8	17 27 8	...	...
II	Barbados	836	25 14 10	17 18 14	3 1 9	8,360	253 26 4	174 28 12	30 15 10	...	...
III	Ditto	684	16 16 14	11 7 8	1 31 12	6,840	164 8 12	114 15 0	17 37 8	...	...
Average of Triplicates		719	19 15 9	12 13 3	2 8 0	7,190	193 35 7	127 32 0	21 26 14	65·8	15·63*

N.B.—The average outturn of *gur* per acre from the seven varieties comes to 77 maunds 35 seers and 12 chittacks, but if 376B. and striped Mauritius be left out of account, the yield per acre rises to 100 maunds 27 seers and 10 chittacks.

* This may be considered outside the experiment as most of the canes died of red root.

The canes were planted on the ridge and furrow system and were manured with cowdung 300 maunds and castorcake 20 maunds per acre.

To prevent any one running away with false ideas of 120 maunds of *gur* per acre from the figures obtained by working out $\frac{1}{16}$th acre plots I submit the following summary for nearly 11 acres of cane grown at this farm in 1912.

	Area.	Yield per acre.
	Acres.	Mds.
Newly planted cane	5½	61-4/8
Ratooned cane	5⅓	40⅓

These results are very good when we consider that the average outturn of cane for the Province is only 30 maunds of *gur* per acre. The only fault I have to find with these thick canes is that they are very delicate to insect pests suffering more than the local varieties while they attract the jackals to an extraordinary degree, which do a tremendous amount of damage to the soft thick varieties.

(C)—Conservation of Cattle-dung.

The farm cowdung is collected and stored in pits, but the effect of storing in covered pits has not been compared with the local method of allowing the manure to be exposed to the weather.

This will be taken up.

(D)—Distribution of Seed.

This farm acts as a centre for the seed supply of this part of the Province. During the year the following seeds, manures and implements were distributed:—

	Mds.
Deepwater paddy	7
C. P. fine aus paddy	2
Badshabhog paddy	1
Chinigura paddy	2
Dadkhani paddy	2
Kataribhog paddy	3
Jute seeds	17

	Mds.
Dhaincha seeds	164½
Jowar seeds	½
Maize	⅛
Wheat	12
Rahar seeds	1¼
Cowpea	¾
Rahar	6¼
Soybean	¼
Sannhemp	½

Dacca ganderi sugarcane cuttings ...	14,600	pieces.
Yellow tanna „ „ ...	700	„
Striped tanna „ „ ...	3,760	„
147 B—Sugarcane cuttings	2,000	„
367 B „ „	3,300	„
Meston plough	2	„
T. C. plough	1	„
Bonemeal	75	maunds.

(E)—Practical Training of Young Men.

During the year 8 men received practical training at this farm. They are now being employed by the Department as Demonstrators.

8. *Receipts and Expenditure.*—During the year April—March 1912-13 the following receipts for this farm were paid into the Treasury: Rs. 11,653-7-3, inclusive of Rs. 157-5-6 for poultry, while Rs. 27,688-9-10 were incurred as expenditure. This compares favourably with receipts Rs. 5,758-2-9 and expenditure Rs. 34,571-8-4 for April-March 1911-12.

Details of expenditure—	Rs.	A.	P.
Farm establishment	6,500	14	4
Permanent improvements ...	822	6	0
Labour	10,269	8	0
Cattle food	1,885	12	6
Repairs	4,187	5	9
Poultry	727	0	0
Miscellaneous	3,295	11	3
	27,688	9	10

The cattle food, repairs and miscellaneous expenses are far too heavy and should be curtailed. The Superintendent can also easily economise on the labour bill.

9. *Acknowledgments.*—I am indebted to Mr. A. A. Meggitt Agricultural Chemist, for the paragraph on the soil; to Mr. R. S. Finlow, for the rainfall figures at the Dacca Farm in 1912-13, and to Mr. H. Field, Officiating Director-General of Observatories, for the normal rainfall and number of rainy days during the past ten years. I take this opportunity of recording my hearty thanks for the help received.

10. *Management.*—The farm is managed by the Agricultural Department. Babu Kali Das Roy was the Superintendent in charge during the year. He is too extravagant.

Mr. Smith inspected the farm frequently while the Director of Agriculture, Mr. Blackwood, visited the station twice. His Excellency the Governor and Lady Carmichael visited the station in July 1912. The Hon'ble Mr. P. C. Lyon also visited the farm during the year under report.

F. Smith,

Deputy Director of Agriculture, Bengal.

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